

BOOK REVIEWS.

Reviews are printed below of four books recently published by the Chronica Botanica Company in "A New Series of Plant Science Books", edited by Dr. Frans Verdoorn.

The periodical *Chronica Botanica*, The International Plant Science News Magazine, was begun in 1935 by Dr. Verdoorn in Holland, the home of internationalism. Early in the war the enterprise was transferred to the United States and has since been carried on with the greatest energy and success. The new series of books on different branches of plant science is the most noteworthy contribution to synthesised botanical presentation that has appeared in recent years. Fourteen volumes have already been published and others are in preparation. The publication of these fine works, each admirable and authoritative in its own sphere, is all the more praiseworthy in view of the difficulties of the present time. Dr. Verdoorn is to be congratulated on the success which has attended his enthusiastic editorship.

Nearly all the volumes published so far, including some translations, have been in English. Dr Verdoorn's remarks are of interest in this connection. "I feel", he writes, "that the volumes of an international series of books, such as the 'New Series of Plant Science Books', should as a rule be in English. An occasional volume in French, German or Spanish may be interspersed to emphasize the international character of the undertaking, but if it is to have a truly international distribution, a book should be in the dominant world language". For this our "one-language scientists" should be humbly grateful.

EDITOR.

F. C. BAWDEN: *Plant Viruses and Virus Diseases* (2nd entirely revised edition, 1943.) Chronica Botanica Co., Waltham, Mass.; agents, Juta and Co., Johannesburg. \$4.75.

Although virus diseases of plants have been recorded as far back as 1576, it is only during the present century that their increasing economic importance has compelled widespread attention. They include disorders of extremely varied types, ranging from severe stunting and necrosis, to a colour change so mild as to escape casual observation; even further than this, viruses can in some cases be present within an

apparently healthy plant and manifest themselves only when transferred to more reactive hosts. The losses they cause vary accordingly from a spectacular devastation of the crop to the opposite extreme of insidious but ever-increasing degeneration.

The study of these diseases constitutes the youngest branch of plant pathology, and their very name was unfamiliar to the majority of botanists even thirty years ago. Since viruses, by reason of the minute size of their particles, are invisible under the best combination of lenses, it was only by their ability to cause infective diseases that their existence was recognized. It was, therefore, inevitable that early investigators, groping amongst so-called "physiological diseases" should have based their studies on the visible symptoms produced in various host-plants by these unseen and unknown agents, and on the means of spread of the infection. During recent years, however, interest has been directed increasingly towards the isolation and examination of these agents themselves, whose obscure nature offered an intriguing problem to scientific workers hitherto unfamiliar with plant pathology. The chemical, physical and medical sciences no less than botany and entomology have given their disciples to this new study, and have contributed to the remarkable progress surveyed in the volume under review. The author is himself a leading investigator in the newer fields of virus research, and has rendered a great service in bringing within one volume a co-ordinated and critical review of a mass of records whose working technique and media of publication are equally beyond the usual range of many plant pathologists.

This book is essentially a progress report of a period of intense activity in virus research, and it cannot escape notice that, of the abundant publications quoted and discussed, relatively few are dated earlier than 1930. So active indeed is the growth of the subject that the second printing of this volume, made necessary by the destruction of the first in Holland, has provided opportunity for extensive revision in order to include advances made during the three intervening years.

Those who have followed the development of virus study will agree that outstanding general interest centres around the successful extraction of viruses from the plants in which they occur as obligate parasites. Much new ground has been broken since the first extracts were prepared, and heated debate has raged around the apparently crystalline proteins which have been isolated from diseased plants and which can reproduce the characteristic and specific disease symptoms in healthy plants. Tobacco Mosaic in particular has been subjected to intense study, and the new methods of purification and analysis have recently resulted in agreement that the nucleoprotein isolated is itself the essential constituent

of the virus and not a contaminant or product of the isolation-processes. Several other distinct viruses have likewise been extracted and purified *in vitro* and have been found to consist solely of nucleoproteins related to that of tobacco mosaic.

While this suggests that the viruses are essentially nucleoproteins, it yet remains to be discovered whether they are present in this form within the plant tissues which they parasitise, and by what mechanism they multiply there. That their form may be modified within the living cell is indicated by the fact that the infectivity of virus preparations may disappear completely as result of treatments which leave their physical and serological characteristics unaltered.

In this connection particular interest attaches to the use of the electron microscope, which enables photographs to be made of the virus in the plant sap. The remarkable photographs reproduced in this volume are a forecast of further important progress in the new fields of microscopy whose technique is now being developed.

In contrast with these physico-chemical aspects, a notable advance of considerable practical importance is the identification of viruses by the use of their specific serological reactions. These differentiate between unrelated viruses and those strains which appear to arise from a parent form in a manner recalling mutation. Related strains can in turn be differentiated by the fact that a host-plant infected with one is immunised against others of its group. These two biological characteristics can be used to provide a basis for classification of viruses and the diseases which they produce. None of the proposed systems of grouping has received universal acceptance, and the existing nomenclature, originating from clinical studies of disease, is in a state of confusion. There is great need of a classification and system of naming which will be soundly based on the characteristics of the better-known viruses and will yet be capable of expansion to include those which still await full investigation.

E. S. MOORE.

W. H. SCHOPFER: *Plants and Vitamins*, pp. xiv + 293 + 3 Plates.
Waltham, Mass., U.S.A., The Chronica Botanica Co.; Johannesburg, Juta & Co., 1943. \$4.75.

A great deal of investigation has been carried out and much written on vitamins. Attention has been chiefly focussed on their biochemistry and on those aspects concerned with human nutrition. Although the plant is the chief source of vitamins and provitamins in animal nutrition, consideration of their possible importance to plants was neglected until

the last decade. In the investigations conducted to establish the rôle of vitamins in plant metabolism, Prof. Schopfer has played a prominent part and he is especially known for his investigations on *Phycomyces Blakesleeanus*.

That *Plants and Vitamins* is a pioneer work in a new field made it desirable to outline the procedure for plant investigations and necessary to stress the difficulties of experimentation and interpretation, which afford many pitfalls for the unwary. This is especially true in relation to trace substances in the nutrient materials used (Chap. III). It also necessitated a consideration of the involved subject of classification, definition and synonymy of substances active in low concentrations (Chiefly Chap. IV). A consideration of terminology is all the more necessary since the current science of vitaminology has been mostly developed by animal physiologists.

The importance of vitamins to plants has been masked because green plants considered as entities are typically able to synthesise their own. An inability of a root to synthesise vitamin B₁ will not be evident since the deficiency will be supplied by the shoot. To elucidate the rôle of vitamins it was necessary to study the nutritional requirements of embryos with their cotyledons removed and of roots isolated from shoots. (Chap. VI).

There are plants, however, that are completely heterotrophic for one or more vitamins (or part of a vitamin). These are chiefly to be found among bacteria, flagellates and fungi. Heterotrophism in relation to a vitamin does not, however, correspond to taxonomic groupings since organisms as diverse as the rat and a yeast may require to be supplied with the same vitamin while two strains of a species may differ in their vitamin requirements (e.g. lactic bacteria. Chap. XIV). The importance which the author attaches to the investigation of auxo-heterotrophic plants in elucidating the fundamental vitamin requirements of plants is indicated by the fact that the greater part of the largest of the three sub-sections of the book is devoted to them. Part II contains a separate chapter on the rather special subject of yeast and bios (Chap. XII) and also separate chapters on the nitrogen fixing bacteria and the haemophilic organisms (Chaps. XV and XVI).

The third part of the book deals with the contributions of vitamin investigations to the understanding of a number of biological and agricultural problems. The presence of vitamins in soil and the effect of fertiliser treatment on the vitamin content of cultivated plants are considered (Chap. XXI). Growth factors in relation to sexuality are then discussed (Chap. XXII). The loss of the ability to synthesise one or more vitamins and the consequent need of an external source is considered in

relation to symbiosis and parasitism (Chap. XXIII). Part III also contains a chapter (Chap. XXIV) devoted to a consideration of the suitability of micro-organisms as test objects for the various vitamins.

Biochemical no less than physiological aspects are dealt with; the chief vitamins synthesised by plants (Chap. V), the important subject of their biosynthesis (Chaps. VIII and IX) and the action of vitamins as coenzymes (Chap. XVIII) are discussed. This tabulation should not give a false impression as biochemical aspects are fully dealt with throughout. This is especially seen in the frequent discussion of specificity of action of the various vitamins. The general approach to the subject, however, is physiological.

Other topics discussed include: growth factors in relation to plant tissue culture (Chap. VII); the action of animal hormones on plants; and the occurrence of estrone in plants.

A reading of this book will show how uneven is our knowledge of the importance of the various vitamins in relation to plants. More is known concerning vitamin B₁ than of the others. Here and throughout, this book is not only useful as a review of present knowledge (although no claim is made for an exhaustive treatment) but also indicates gaps in our knowledge needing further investigations.

Prof. Schopfer in discussing the classification of active substances expresses the view that "general mode of action" is to be preferred as a criterion since it is a physiological one (p. 38). In his formal definition of a vitamin, however, he insists on exogenous origin: a vitamin "is required by an organism because the latter has lost the capacity to synthesise it" (p. 195). This would seem to be viewing the matter too exclusively from the angle of the food analyst. The term represents a group of substances which are physiologically necessary irrespective of whether an organism is able to synthesise them or not. A second comment relating to the proposed definition of a vitamin concerns the introduction of a "new criterion": that a vitamin functions as a coenzyme or fragment of a coenzyme. The enzymatic nature of vitamin functioning is stressed throughout the book. This is in agreement with recent investigations but our knowledge is still incomplete. To include it as part of a theory or hypothesis would be appropriate but it seems somewhat out of place in a definition.

The English text contains a few ambiguous sentences. There are also a number of errors. Thus on p. 56 a table gives the ascorbic acid content of a number of plant organs as "mg/kg". This should be "mg/gm" or "gm/kg". Table IV (p. 68) shows that of the plant roots considered, flax has the greatest capacity for vitamin synthesis (which is correct) while the text states that this is true of the roots of

the radish. On p. 120, substitution of NH_2 in the "second position" of the pyrimidine nucleus should read "fourth position". Some of the statements relating to animals are rather too generalised in view of the author's claim to consider his subject from the wider aspect of general physiology.

These, however, are minor criticisms of a stimulating book packed with information which is well arranged, documented and lucidly expounded and contains many indications of directions in which further useful research could be carried out. Moreover, it is a book that will undoubtedly appeal to many workers in a number of scientific fields; to those working on vitamin problems in relation to plants it will be indispensable.

WM. EDWYN ISAAC.

G. ERDTMAN: An Introduction to Pollen Analysis, xvi + 240 pp.
Price \$5.00. Waltham, Mass., U.S.A., The Chronica Botanica Co.;
Johannesburg, Juta & Co., Ltd., 1943.

The study of pollen from the point of view of the causation of allergic affections is of great practical significance. The present volume, giving an account of another aspect of the study, shows how it can lead—through paths of much obscurity and difficulty—to results of historical and theoretical interest. Pollen Analysis has given rise in the last few decades to a copious literature, cited by Dr. Erdtman with remarkable fullness, and to which he has himself largely contributed. From this has emerged a broader understanding of the various phases of plant migration and vegetational succession in the period succeeding the ice ages in the northern hemisphere.

The vast quantities of pollen liberated by anemophilous plants (including many dominant forest trees) combined with the relative imperishability of the walls of the grains has brought about their preservation in peat, recent alluvial deposits, etc. in great numbers. Their extraction and identification has become a fairly simple matter. Erdtman gives a valuable account of the methods employed in recovering pollen grains from such materials; and a great part of his book is a systematic description, fully illustrated, of the manifold types of grain produced by different families, genera and species. Erdtman gives estimates of the amount of pollen produced by several plants, the figures being fantastically enormous. A single stamen of Rye, for instance, produces 19,000 pollen grains: a single male cone of *Pinus nigra* produces 1,480,000 grains: a stand of *Pinus sylvestris* 100 m. square produces in 50 years 322,750,000,000 grains. *Calluna vulgaris* (the 'ling' heather) deposits annually 4,060 million grains on each square metre of soil beneath it.

From studies of the pollen grains embedded in deposits of peat, etc. it should be possible to arrive at a knowledge of the types of vegetation present in the neighbourhood during its period of formation. But hasty conclusions have to be avoided for several reasons, the chief of which is the great distance over which pollen grains may be transported by wind. Abundant pollen grains have been trapped on lightships at sea, by aeroplanes, on a North Atlantic voyage, and so on. A peat deposit from Greenland contained 355 coniferous pollen grains per gram dry weight, and identifications indicated a North American source for these—i.e. a distance travelled of 1,000 km. or more. This factor and others—such as the differences in rates of decay of different pollens, and the sinking and percolation of grains,—as well as problems such as suggested by the distribution of supposed pollen of *Tilia*, an entomophilous tree—have to be cautiously taken into account in basing historical conclusions on stratigraphy.

Vegetation problems are given the greatest prominence in this book, but short allusion is made to other topics in which pollen analysis is capable of giving interesting results. For instance, in archaeological studies it is sometimes possible to assign a stone implement to its horizon by the adhering pollen grains. The pollen contained in honey and drugs may give proof of adulteration—e.g. in a case of "Scotch Heather Honey" which was found to contain *Leptospermum* pollen.

A valuable chapter on the chemistry of peat, by the author's brother, Dr. H. Erdtman, is included.

Cordial thanks are due to the author for his admirable presentation of the actively growing subject of Pollen Analysis. For the way in which the great difficulties of language have been overcome, Dr. Erdtman and the editor, Dr. Frans Verdoorn, must share the gratitude of English readers.

R. H. COMPTON.

D. R. HOAGLAND: *Lectures on the Inorganic Nutrition of Plants.* (Prather Lectures.) 226 pages, including 28 plates. Waltham, Mass., The Chronica Botanica Co.; Johannesburg, Juta & Co., Ltd., 1944. \$4.00.

As stated in the preface, *Inorganic Nutrition of Plants* is not a monograph. Prof. Hoagland, who is well known for his work in this field, places in broad perspective certain important aspects of this extensive subject. The scope is further limited in that the data used are chiefly those established in California. This and the relatively small compass of the book explain the absence of reference to the researches of some prominent investigators. Even with these self-imposed limitations, how-

ever, the book inevitably tends to be somewhat episodic in places. An attempt has been made to avoid this by following up a general introduction to a subject with a more detailed consideration of one facet. Thus a general discussion on micronutrients is followed by an account of investigations on zinc as illustrative of the problems and considerations involved.

The first lecture, besides being introductory, deals with the soil solution, including its relation to base exchange in soil colloids. Then follows an account of micronutrient elements essential to plant growth (Lect. 2). Hoagland regards copper and zinc as well as boron and manganese, as essential. A discussion on the absorption and accumulation of salts (Lect. 3) and of the factors governing their movement and distribution in the plant together with a consideration of the relation of water absorption to salt absorption (Lect. 4) follows. The importance of general metabolism and aerobic conditions for salt absorption, accumulation, and movement within the plant is stressed. Here as elsewhere, the value of researches using radioactive isotopes is shown. The technique and principles of artificial plant culture in liquid and pure sand media, and its rôle in plant nutrition investigations is examined in Lecture 5. In the following lecture various biochemical problems relating to salt absorption are dealt with. Selective ion absorption is considered in relation to organic acid synthesis and the absorption of nitrate and ammonium ions in relation to synthesis of amides. Related respiratory effects are considered. In the last lecture investigations relating to potassium are used to illustrate the complex of inter-related considerations (especially in regard to the soil) involved in studying plant nutrition. Many matters are dealt with in greater or lesser detail in addition to those mentioned above but an attempt has been made to indicate the general trend of the book.

Speculative aspects of the subject are considered but care is taken to distinguish between such speculation and generalisations based on adequate data. Frequently, however, the available data are inadequate and this inadequacy and the directions in which further investigation is necessary are emphasised. We are also given glimpses of work in progress.

The book has two outstanding merits. The need of regarding any function in relation to the entire metabolism of the plant in its setting of soil and climatic conditions is always borne in mind. Secondly, Prof. Hoagland's connection with agricultural science makes him alive to agricultural applications of researches on plant nutrition and to the contributions which field tests and observations can make to the interpretation of laboratory investigations.

WM. EDWYN ISAAC.